Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application. Applicant has submitted a new complete claim set showing marked up claims with insertions indicated by underlining and deletions indicated by strikeouts and/or double bracketing.

Listing of Claims:

1. (Currently amended) A method comprising:

computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair, the stereo disparity model distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line, the computing comprising using a three-layer graph for dynamic programming.

2. (Original) The method of claim 1 wherein the computing operation comprises:

computing matching costs for each pixel of each scan line pair.

3. (Original) The method of claim 1 wherein the computing operation comprises:

computing matching costs for each pixel of each scan line pair using a windowed matching cost function.

4. (Original) The method of claim 1 wherein the computing operation comprises:

altering the matching costs for at least one pixel pair based on whether the pixel pair is determined to be associated with a non-fronto-parallel surface or an occlusion.

5. (Currently amended) The method of claim 1 wherein the computing operation comprises:

determining a minimum cost path in the stereo disparity model using anisotropic smoothing.

6. (Original) The method of claim 1 wherein the computing operation comprises:

applying a cost penalty to a move from an occluded pixel pair to a matched pixel pair.

7. (Original) The method of claim 1 wherein the computing operation comprises:

applying a cost penalty to a move from a matched pixel pair to an occluded pixel pair.

8. (Original) The method of claim 1 wherein the computing operation comprises:

applying a cost penalty to a move from an occluded pixel pair to another occluded pixel pair.

9. (Original) The method of claim 1 wherein the computing operation comprises:

applying a first cost penalty to a move from an occluded pixel pair to another occluded pixel pair; and

applying a second cost penalty to a move from a matched pixel pair to an occluded pixel pair, the first cost penalty being different than the second cost penalty.

10. (Original) The method of claim 1 wherein the computing operation comprises:

applying a first cost penalty to a move from an occluded pixel pair to another occluded pixel pair; and

applying a second cost penalty to a move from a matched pixel pair to an occluded pixel pair, the first cost penalty being less than the second cost penalty.

11. (Original) The method of claim 1 further comprising:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, a disparity of the corresponding pixels being characterized by a minimum cost path of the stereo disparity model.

12. (Original) The method of claim 1 further comprising:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein

corresponding pixels that are matched are projected as a virtual pixel onto the cyclopean virtual image scan line.

13. (Original) The method of claim 1 further comprising:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein corresponding pixels that are averaged to determined a value of a resulting virtual pixel on the cyclopean virtual image scan line.

14. (Original) The method of claim 1 further comprising:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein a non-occluded pixel of an occluded pair of corresponding pixels is projected as a virtual pixel onto the cyclopean virtual image scan line from a background disparity in the stereo disparity model.

15. (Original) The method of claim 1 further comprising:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein a value of a non-occluded pixel of an occluded pair of corresponding pixels is selected as a value of a resulting virtual pixel on the cyclopean virtual image scan line.

16. (Currently amended) A computer program product encoding a computer program for executing on a computer system a computer process, the computer process comprising:

computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair, the stereo disparity model distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line, the computing comprising using a three-layer-graph for dynamic programming.

17. (Original) The computer program product of claim 16 wherein the computing operation comprises:

computing matching costs for each pixel of each scan line pair.

18. (Original) The computer program product of claim 16 wherein the computing operation comprises:

computing matching costs for each pixel of each scan line pair using a windowed matching cost function.

19. (Original) The computer program product of claim 16 wherein the computing operation comprises:

altering the matching costs for at least one pixel pair based on whether the pixel pair is determined to be associated with a non-fronto-parallel surface or an occlusion.

20. (Currently amended) The computer program product of claim 16 wherein the computing operation comprises:

determining a minimum cost path in the stereo disparity model using anisotropic smoothing.

21. (Original) The computer program product of claim 16 wherein the computing operation comprises:

applying a cost penalty to a move from an occluded pixel pair to a matched pixel pair.

22. (Original) The computer program product of claim 16 wherein the computing operation comprises:

applying a cost penalty to a move from a matched pixel pair to an occluded pixel pair.

23. (Original) The computer program product of claim 16 wherein the computing operation comprises:

applying a cost penalty to a move from an occluded pixel pair to another occluded pixel pair.

24. (Original) The computer program product of claim 16 wherein the computing operation comprises:

applying a first cost penalty to a move from an occluded pixel pair to another occluded pixel pair; and

applying a second cost penalty to a move from a matched pixel pair to an occluded pixel pair, the first cost penalty being different than the second cost penalty.

25. (Original) The computer program product of claim 16 wherein the computing operation comprises:

applying a first cost penalty to a move from an occluded pixel pair to another occluded pixel pair; and

applying a second cost penalty to a move from a matched pixel pair to an occluded pixel pair, the first cost penalty being less than the second cost penalty.

26. (Original) The computer program product of claim 16 wherein the computer process further comprises:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, a disparity of the corresponding pixels being characterized by a minimum cost path of the stereo disparity model.

27. (Original) The computer program product of claim 16 wherein the computer process further comprises:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein corresponding pixels that are matched are projected as a virtual pixel onto the cyclopean virtual image scan line.

28. (Original) The computer program product of claim 16 wherein the computer process further comprises:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein corresponding pixels that are averaged to determined a value of a resulting virtual pixel on the cyclopean virtual image scan line.

29. (Original) The computer program product of claim 16 wherein the computer process further comprises:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein a non-occluded pixel of an occluded pair of corresponding pixels is projected as a virtual pixel onto the cyclopean virtual image scan line from a background disparity in the stereo disparity model.

30. (Original) The computer program product of claim 16 wherein the computer process further comprises:

computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein a value of a non-occluded pixel of an occluded pair of corresponding pixels is selected as a value of a resulting virtual pixel on the cyclopean virtual image scan line.

31. (Currently Amended) A system comprising:

a dynamic programming module configured to use a three-layer-graph for dynamic programming to compute[[ing]] a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair, the stereo disparity model distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line; and

a processor.

32. (Original) The system of claim 31 wherein the dynamic programming module computes matching costs for each pixel of each scan line pair.

33. (Original) The system of claim 31 wherein the dynamic programming module computes matching costs for each pixel of each scan line pair using a windowed matching cost function.

34. (Original) The system of claim 31 wherein the dynamic programming module alters the matching costs for at least one pixel pair based on whether the pixel pair is determined to be associated with a non-fronto-parallel surface or an occlusion.

35. (Currently amended) The system of claim 31 wherein the dynamic programming module determines a minimum cost path in the stereo disparity model using anisotropic smoothing.

36. (Original) The system of claim 31 wherein the dynamic programming module applies a cost penalty to a move from an occluded pixel pair to a matched pixel pair.

37. (Original) The system of claim 31 wherein the dynamic programming module applies a cost penalty to a move from a matched pixel pair to an occluded pixel pair.

38. (Original) The system of claim 31 wherein the dynamic programming module applies a cost penalty to a move from an occluded pixel pair to another occluded pixel pair.

39. (Original) The system of claim 31 wherein the dynamic programming module applies a first cost penalty to a move from an occluded pixel pair to another occluded pixel pair and a second cost penalty to a move from a matched pixel pair to an occluded pixel pair, the first cost penalty being different than the second cost penalty.

40. (Original) The system of claim 31 wherein the dynamic programming module applies a first cost penalty to a move from an occluded pixel pair to another occluded pixel pair and a second cost penalty to a move from a matched pixel pair to an occluded pixel pair, the first cost penalty being less than the second cost penalty.

41. (Original) The system of claim 31 further comprising:

a cyclopean virtual image generator computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, a disparity of the corresponding pixels being characterized by a minimum cost path of the stereo disparity model.

42. (Original) The system of claim 31 further comprising:

a cyclopean virtual image generator computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein corresponding pixels that are matched are projected as a virtual pixel onto the cyclopean virtual image scan line.

43. (Original) The system of claim 31 further comprising:

a cyclopean virtual image generator computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein corresponding pixels that are averaged to determined a value of a resulting virtual pixel on the cyclopean virtual image scan line.

44. (Original) The system of claim 31 further comprising:

a cyclopean virtual image generator computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein a non-occluded pixel of an occluded pair of corresponding pixels is projected as a virtual pixel onto the cyclopean virtual image scan line from a background disparity in the stereo disparity model.

45. (Original) The system of claim 31 further comprising:

a cyclopean virtual image generator computing a cyclopean virtual image scan line based on corresponding pixels of the scan lines of the first and second images, wherein a value of a non-occluded pixel of an occluded pair of corresponding pixels is selected as a value of a resulting virtual pixel on the cyclopean virtual image scan line.

REMARKS

This paper is responsive to the Non-Final Office Action dated September 12, 2007. Claims 1-45 were and remain pending. Claims 1, 5, 16, 20, 31 and 35 have been amended to further clarify the invention.

Rejection under 35 U.S.C. 102(b)

Claims 1, 2, 4, 5, 16, 17, 19, 20, 31, 32, 34, and 35 were rejected under 35 U.S.C. 102(b) as being unpatentable over Roy (U.S. Patent No. 6,046,763). This rejection is respectfully traversed.

Claim 1

Claim 1 as amended recites:

> A method comprising:
> **computing a minimum cost path** in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair, the stereo disparity model **distinguishing between non-fronto-parallel matched pixels** in each scan line **and occluded pixels** in each scan line, the computing comprising **using a three-layer graph for dynamic programming**.
> (Emphasis added).

Roy, however, discusses using **maximum-flow estimation** without concern for epipolar lines. (Col. 1 lines 49-52, Emphasis added).

Roy uses maximum-flow analysis rather than minimum cost analysis. While these two approaches may end with the same result in some circumstances, they are not the same. Costs may not always equate to flow capabilities. Focusing on one approach rather than the other may lead to differing optimizations. Roy does not teach computing a minimum cost path.

The Examiner states that "reg(u,v) is read as the non-fronto-parallel pixels" (page 2, second paragraph from bottom). Roy states "where reg(u,v) is a cost characterized by the absence of occlusion (i.e. regular)" (col 5, lines 53-54). Non-

fronto-parallel pixels, however, refer to a surface that is substantially parallel to an axis connecting the left and right cameras. (p. 5, lines 16-18). Roy does not anticipate "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line."

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

Roy does not anticipate "computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair," "using a three-layer graph for dynamic programming," or "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line." Accordingly, claim 1 is allowable over the cited reference and the rejection should be withdrawn.

Claims 2-15

Claims 2-15 depend from claim 1 and are allowable at least by virtue of that dependency. Accordingly, the rejection of these claims should also be withdrawn.

Claims 16 and 31

Claims 16 and 31have been amended to recite the same limitations as claim 1, "computing a **minimum cost path** in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair," using "**a three-layer graph for dynamic programming,**" and "**distinguishing between non-fronto-parallel** matched pixels in each scan line **and occluded pixels** in each scan line." The argument distinguishing claim 1 from Roy also applies to claim 16 and to claim 31.

Claims 17-30 and 32-45

Claims 17-30 depend from claim 16 and are allowable at least by virtue of that dependency. Accordingly, the rejection of these claims should also be withdrawn.

Claims 32-45 depend from claim 31 and are allowable at least by virtue of that dependency. Accordingly, the rejection of these claims should also be withdrawn.

Rejection under 35 U.S.C. 103(a)

Claims 3, 18, and 33

Claims 3, 18, and 33 were rejected under U.S.C. 103(a) as being unpatentable over Roy ('763) as applied to claim 1, further in view of Chupeau (U.S. Patent No. 5,727,078).

As described above under the argument for claim 1, Roy does not anticipate "computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair," "using a three-layer graph for dynamic programming," or "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line." Chupeau does not remedy this deficiency.

Neither Roy and Chupeau disclose, either separately or in combination, "computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair," "using a three-layer graph for dynamic programming," or "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line." Accordingly, applicants submit that claims 3, 18, and 33 are not unpatentable over the combination of Roy and Chupeau under 35 U.S.C. §103(a), and withdrawal of the rejection and allowance of claims 3, 18, and 33 are respectfully requested.

Claims 6-10, 21-25, and 36-40

Claims 6-10, 21-25, and 36-40 were rejected under U.S.C. 103(a) as being unpatentable over Roy ('763) as applied to claim 1, further in view of Usami (U.S. Patent No. 4,982,438).

As described above under the argument for claim 1, Roy does not anticipate "computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair," "using a three-layer graph for dynamic programming," or "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line." Usami does not remedy this deficiency.

Neither Roy and Usami disclose, either separately or in combination, "computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair," "using a three-layer graph for dynamic programming," or "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line." Accordingly, applicants submit that claims 6-10, 21-25, and 36-40 are not unpatentable over the combination of Roy and Usami under 35 U.S.C. §103(a), and withdrawal of the rejection and allowance of claims 6-10, 21-25, and 36-40 are respectfully requested.

Claims 11, 12, 14, 15, 26, 27, 29, 30, 41, 42, 44 and 45

Claims 11, 12, 14, 15, 26, 27, 29, 30, 41, 42, 44 and 45 were rejected under U.S.C. 103(a) as being unpatentable over Roy ('763) as applied to claim 1, further in view of Chen (U.S. Patent No. 6,556,704).

As described above under the argument for claim 1, Roy does not anticipate "computing a minimum cost path in a stereo disparity model between a scan line of a

first image and a corresponding scan line of a second image of a stereo image pair," "using a three-layer graph for dynamic programming," or "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line." Chen does not remedy this deficiency.

Neither Roy and Chen disclose, either separately or in combination, "computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair," "using a three-layer graph for dynamic programming," or "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line." Accordingly, applicants submit that claims 11, 12, 14, 15, 26, 27, 29, 30, 41, 42, 44 and 45 are not unpatentable over the combination of Roy and Chen under 35 U.S.C. §103(a), and withdrawal of the rejection and allowance of claims 11, 12, 14, 15, 26, 27, 29, 30, 41, 42, 44 and 45 are respectfully requested.

Claims 13, 28, and 43

Claims 13, 28, and 43 were rejected under U.S.C. 103(a) as being unpatentable over Roy ('763) as applied to claim 1, further in view of Anandan (U.S. Patent No. 6,198,852).

As described above under the argument for claim 1, Roy does not anticipate "computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair," "using a three-layer graph for dynamic programming," or "distinguishing between non-fronto-parallel matched pixels in each scan line and occluded pixels in each scan line." Anandan does not remedy this deficiency.

Neither Roy and Anandan disclose, either separately or in combination, "computing a minimum cost path in a stereo disparity model between a scan line of a first image and a corresponding scan line of a second image of a stereo image pair,"